

RESEARCH HIGHLIGHT
Basic Energy Sciences Program
Geosciences Subprogram

Project: 3D Electromagnetic Modeling and Inversion

Who and Where: Gregory Newman, Sandia National Laboratories

Objectives: The objective of this research is to develop and analyze techniques for quantifying the resolution of, and appraising the accuracy of images produced by 2D and 3D electromagnetic inversion schemes, and to apply these techniques to field data.

Results & Significance: Exxon Corporation signed a \$100K license agreement with Sandia National Laboratories, Geoscience and Environmental Technology Center for 3D electromagnetic modeling and imaging software. Exxon intends to use the software to help characterize the fluid properties of oil reservoirs. The \$10K/year of technical assistance from Sandia for two years is also included in the deal. Sandia has been developing the software over the last nine years under its basic research programs in earth science, with funding provided by the Office of Basic Energy Sciences and Laboratory Director Research and Development Funds. The software has been designed for massively parallel computing platforms so realistic problems, involving electromagnetic wave propagation within the earth, can be simulated in a reasonable amount of time. The philosophy in developing the software has been to carry out the computer simulations with as much rigor as possible and to avoid approximations, which sacrifice accuracy for speed. Exxon approached Sandia to license the software because of these unique capabilities. They also did not want to devote the resources to develop such a capability within Exxon because of the time and money commitment that would be involved. Exxon plans to modify these basic research codes for their specific applications and commercial interest. The success of this license demonstrates the unexpected and unplanned benefits of basic scientific research. Additional licenses for single processor versions of the software have also been negotiated this year with Halliburton Energy Services and Electromagnetic Instruments of Richmond California this year.

Publication: A paper entitled "Three-dimensional magnetotelluric inversion using nonlinear conjugate gradients" has been accepted for publication in the *Geophysical Journal International*. The paper has been cited as presenting new and significant work on a difficult computational problem, which is of great importance in electromagnetic studies of the Earth. Its use of massively parallel computing architectures is also a noteworthy innovation.